

CLAIMS

What is claimed is:

1. A response device compatible with a magnetic resonance imaging (MRI) apparatus and similar medical techniques associated with strong magnetic environments, the device comprising:
 - a. A keypad connected with a fiber optic cable to an electronic unit that includes photoelectric means for illuminating optical fibers in said fiber optic cable, photo-detecting means for detecting the light coming from said keypad through said fiber optic cable, and signal processing means for processing signals from said photo-detecting means, and communication with external devices;
 - b. Fiber optic push-button switches that are located in said keypad to be pressed by a patient who is undergoing a response test, each said fiber optic switch comprising:
 - (b1) A base and an actuator that can move in said base while being pushed at the depressing end;
 - (b2) A spring that keeps said actuator in a fixed position in said base when said actuator is not depressed;
 - (b3) An illuminating fiber that provides light to a shutter that is attached to another end of said actuator;
 - (b4) A receiving fiber that is located in said base coaxially with said illuminating fiber, said receiving and illuminating fibers providing a gap for sliding said shutter in it when said shutter moves in said base.
 - c. A body of said keypad represents a box with a plurality holes in the front, left, and right sides for mounting of said fiber optic push-button switches in different locations on the keypad.

2. The response device of claim 1 wherein each said fiber optic push-button switch comprises:
 - a. A base and an actuator that can move in said base while being pushed at the depressing end;
 - b. A spring that keeps said actuator in a fixed position in said base when said actuator is not depressed;
 - c. An optical fiber that provides light to a reflective surface at another end of said actuator and collects light that is reflected from said reflective surface.
3. The response device of claim 1 wherein:
 - a. Said base of said fiber optic push-button switch has snapping means on its top surface;
 - b. An internal surface of said box has snapping means that mate with said snapping means of said base;
 - c. Said fiber optic push-button switch is mounted inside of said box by mating said snapping means on said base and said internal surface;
 - d. Said depressing end of said actuator is facing out from an external surface of said box at a distance from 2 mm to 20 mm;
 - e. Said depressing end of said actuator is inserted in one of said openings in said box;
 - f. Said depressing end of said actuator can slide in an opening where it is inserted.
4. The response device of claim 1 wherein:
 - a. Said base of said fiber optic push-button switch has snapping means on its bottom surface;

- b. An internal surface of said box has snapping means that mate with said snapping means of said base;
- c. Said fiber optic push-button switch is mounted inside of said box by mating said snapping means on said base and said internal surface;
- d. Said depressing end of said actuator is facing out from the external surface of said box at a distance from 2 mm to 20 mm;
- e. Said depressing end of said actuator is inserted in one of said openings in said box;
- f. Said depressing end of said actuator can slide in an opening where it is inserted.

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- 5. The response device of claim 1 wherein said fiber optic push-button switches are located on said box in positions that provide ergonomic depressing of said switches with fingers.

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- 6. The response device of claim 1 wherein two keypads are connected to said electronic unit, one keypad to be activated with the left hand and another keypad to be activated with the right hand.

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- 7. The response device of claim 1 wherein said fiber optic push-button switches are located on said box in positions that are equidistant from a central opening on the front side of said box.

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- 8. The response device of claim 7 wherein said four fiber optic push-button switches are located on said front side in a square arrangement.

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9. The response device of claim 7 wherein said eight fiber optic push-button switches are located on said front side in a circular arrangement.

5 10. The response device of claim 7 further comprising:

- a. A knob that is inserted into said central opening;
- b. Said knob has a flange that can touch all said depressing ends of said fiber optic push-button switches;
- c. Said knob can be tilted and rotated inside said central opening and said flange can press said depressing ends of said fiber optic push-button.

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11. The response device of claim 10 further comprising:

- a. A handle with a start button on it;
- b. Said start button is connected to a movable fiber optic switch that is inside of said box and is attached to the end of said handle that is inserted into said central opening.

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12. The response device of claim 10 further comprising:

- a. An elastic ring that is located under said flange;
- b. Said ring holds said knob perpendicular to front side of said box if said knob is not tilted;
- c. An insertion part of said knob has fixing means that prevent said knob from being removed from said box when said knob is tilted and rotated.

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13. The response device of claim 6 wherein:

- a. Said keypads are connected with peripheral fiber optic cables to a Y-box;
- b. Said Y-box is connected to said electronic unit with a main fiber optic cable.

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14. The response device of claim 13 further comprising:

- a. A third keypad with said knob in it;
- b. Said third keypad is connected with said peripheral fiber optic cable to said Y-box.

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15. The response device of claim 14 wherein:

- a. Said main fiber optic cable has a length from 10 m to 30 m;
- b. Said peripheral fiber optic cable has a length from 0.5 m to
10 2.5 m.

16. The response device of claim 1 wherein:

- a. Said electronic unit has a plurality of light sources coupled to illuminating optical fibers of said main fiber optic cable;
- b. Said electronic unit has a plurality of photo-detectors coupled to receiving optical fibers of said main fiber optic cable;
- c. Said light sources and photo-detectors are controlled by a micro-controller;
- d. Said micro-controller provides output signals that correspond to pressing events of said fiber optic push-button switches.

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17. The response device of claim 16 wherein said micro-controller provides output signals that are synchronized with external sound or visual stimuli that are provided to said patient.

18. The response device of claim 16 wherein said micro-controller provides output signals that are synchronized with signals from the MRI scanner.

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19. The response device of claim 1 wherein said micro-controller provides an indication on a screen located on said electronic unit about which said fiber optic push-button switches are depressed at each moment.

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20. The response device of claim 1 wherein all parts, except said electronic unit, are made of non-ferrous materials.

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